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IS 12317-1 (1988): Ceramic and glass insulating materials for telecommunication and allied purposes, Part 1: General requirements and classification of ceramic and glass insulating materials [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]



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Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

**SPECIFICATION FOR
CERAMIC AND GLASS INSULATING
MATERIALS FOR TELECOMMUNICATION
AND ALLIED PURPOSES**

**PART 1 GENERAL REQUIREMENTS AND CLASSIFICATION OF CERAMIC
AND GLASS INSULATING MATERIALS**

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SPECIFICATION FOR CERAMIC AND GLASS INSULATING MATERIALS FOR TELECOMMUNICATION AND ALLIED PURPOSES

PART 1 GENERAL REQUIREMENTS AND CLASSIFICATION OF CERAMIC AND GLASS INSULATING MATERIALS

0. FOREWORD

0.1 This Indian Standard (Part 1) was adopted by the Bureau of Indian Standards on 22 March 1988, after the draft finalized by the Solid Electrical Insulating Materials Sectional Committee had been approved by the Electrotechnical Division Council.

0.2 The Indian Standard IS : 6659-1976* giving definition and general requirements was originally published in 1971. First revision of this standard was published in 1976, to include requirements of certain other grades of ceramics. Methods of tests for ceramics for telecommunication and allied purposes are covered by IS : 7571-1974†.

0.3 This standard is being brought out in three parts as under:

- Part 1 Definitions, classification and general requirements;
- Part 2 Methods of tests; and
- Part 3 Specification for individual materials.

0.3.1 With the publication of Part 1 and Part 3 of this standard, all grades of ceramics in different sections of IS : 6659-1976* shall be withdrawn and with the publication of Part 2 of this standard IS : 7571-1974† shall be

withdrawn, aligning the text of this standard in line with the development at IEC level. This standard will include the requirements of porcelain materials also for high frequency.

0.4 This standard (Part 1) covers the general requirements and classification of ceramics and glass insulating materials for telecommunication and allied purposes.

0.5 In preparing this standard, considerable assistance has been derived from IEC Pub 672-1 (1980) 'Specification for ceramic and glass insulating materials : Part 1 Definition and classification', issued by the International Electrotechnical Commission.

0.6 Specification for ceramic insulating materials used for manufacture of bushings and insulators are covered by IS : 8765-1978*.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960†. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Electronic grade ceramic materials (*first revision*).

†Methods of tests for ceramics for telecommunication and allied purposes.

*Ceramic insulating materials for electrical purposes.

†Rules for rounding of numerical values (*revised*).

1. SCOPE

1.1 This standard (Part 1) covers the requirements, classification and definitions applicable to ceramic, glass and glass-ceramic materials used as electrical insulating material.

1.2 This standard does not cover the requirements of porcelain materials required for power frequency application.

2. TERMINOLOGY

2.1 For the purpose of this standard the following terms in addition to those covered in IS : 1885 (Part 62)-1985* shall be applicable.

*Electrotechnical vocabulary: Part 62 Solid insulating materials.

2.2 Ceramic Insulating Materials — Inorganic material shaped before firing of which the principal constituents usually comprise polycrystalline silicates, alumino-silicates, titanates, or oxides.

2.3 Glass Insulating Materials — Melted or sintered vitreous inorganic materials which have solidified essentially without crystallization.

2.3.1 Annealed Glass — Glass slowly cooled from the annealing temperature so that the residual stresses can be neglected in relation to any applied stress.

2.3.2 Toughened Glass — Glass prepared by prestressing so that all body surfaces are in compression and the interior tension zone is thus fully protected by the compressed skin.

2.4 Glass-Ceramic Materials — Insulating materials, derived from glass which has been treated to induce a substantial amount of crystallinity.

2.5 Glazes — Coatings substantially of glass obtained by melting and having a smooth surface. They may contain colouring or specifying components.

2.6 Fuchsine Porosity — An indication of liquid absorption by means of fuchsine dye penetration under pressure.

2.7 Bulk Density (P_d) — The quotient obtained by dividing the mass of the test specimen by the apparent volume (including open and closed pores).

2.8 Open (Apparent) Porosity (P_a) — The ratio of the volume of open pores to the apparent volume expressed as a percentage.

2.9 Transformation Temperature (T_g) — Defined by an inflexion in the temperature-expansion curve of glass when heated at a constant rate. At the inflexion temperature, internal stresses in the glass are reduced within a few minutes.

2.10 Resistance to Thermal Shock (Δt) — The ability of the material to withstand rapid changes in temperature, normally determined by transference of specimens from a hot oven to a cold water bath.

3. GROUPING (CLASSIFICATION)

3.1 The composition and properties, groups of ceramic materials are given below:

C_1 — ceramics based on alkaline, alumino-silicates (porcelain).

C_2 — ceramics based on magnesium silicates (steatites and forsterites).

C_3 — ceramics dielectrics based on titania or titanates modified with stannates or zirconates niobate (high permittivity ceramics) :

(a) TiO_2 , (b) $MgO TiO_2$, (c) $CaOTiO_3$,
(d) $BaOZrO_2$, (e) $SrO TiO_2$,
(f) $BaO TiO_2$

C_4 — ceramics based on alkaline — earth alumino — silicates.

C_5 — ceramics based on alumino silicates (mullite ceramics, Al_2O_3 , SiO_2 very low alkali).

C_6 — high alumina ceramics.

C_7 — special oxide ceramics [(a) Al_2O_3 ,
(b) MgO , (c) ZrO_2].

3.1.1 C_1 , C_2 and C_4 groups of ceramics are having silicates as an essential ingredients and have found extensive use in high frequency applications due to its low power losses at high frequency.

3.1.2 C_3 — This group of ceramics is used as dielectrics in capacitors.

3.1.3 C_5 and C_6 — These groups of ceramics are used as substrate for film resistors.

3.1.4 C_7 — This group is used as having high dielectric properties at both high and low temperature as such are used in manufacturing of resistor tubes, vacuum tubes and insulators, etc. Since these ceramics have excellent mechanical properties with good stability at elevated temperature.

3.2 Depending upon the composition and properties groups of glass insulating materials are given below:

G_1 — alkali-lime-silica glasses

G_2 — chemically resistant borosilicate glasses

G_3 — electrically resistant borosilicate glasses

G_4 — alumina-lime-silica glasses

G_5 — lead oxide-alkali-silica glasses

G_6 — barium oxide-alkali-silica glasses

3.3 The composition and properties groups of glass-ceramic materials will be designated as GC.